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Aarkrog, A.; Lippert, Jørgen Emil

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Environmental Radioactivity in the Faroes in 1972

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A. Aarkrog and J. Lippert

Danish Atomic Energy Commission
Research Establishment Risø
Health Physics Department

Abstract

Measurements of fall-out radioactivity in the Faroes in 1972 are presented. ^{90}Sr (and ^{137}Cs in most instances) was determined in regularly collected samples of precipitation, grass, milk, lamb, fish, sea water, bread, and drinking water. In addition, analyses of spot samples of potatoes, sea plants, vegetables, eggs, and human bone were carried out. Estimates of the mean contents of ^{90}Sr and ^{137}Cs in the human diet in the Faroes in 1972 are given.

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CONTENTS

ABBREVIATIONS AND UNITS

FP	fission products
pCi	picocurie, 10^{-12} Ci, μμCi
nCi	nanocurie, 10^{-9} Ci, mμCi
mCi	millicurie, 10^{-3} Ci
MPC	maximum permissible concentration
S.U.	pCi ^{90}Sr/g Ca
O.R.	observed ratio
M.U.	pCi ^{137}Cs/g K
n Sr	natural (stable) Sr
S.D.	standard deviation, $\sqrt{\frac{\Sigma(\bar{x}-x_i)^2}{(n-1)}}$
S.E.	standard error, $\sqrt{\frac{\Sigma(\bar{x}-x_i)^2}{n(n-1)}}$
S.S.D.	sum of squares of deviations, $\Sigma(\bar{x}-x_i)^2$
f	degrees of freedom
s^2	variance
v^2	ratio between the variance in question and the residual variance
P	probability fractile of the distribution in question
$\bar{x}$	mean values
Σ	sum
η	coefficient of variation, relative standard deviation

1. INTRODUCTION

1.1.

The fall-out programme for the Faroes, which was initiated in 1962[1] in close co-operation with the National Health Service and the chief physician of the Faroes, was continued in 1972. Samples of human bone were obtained in 1972 from Dronning Alexandrines Hospital in Thorshavn.

1.2.

The present report will not repeat information concerning sample collection and analysis already given in Risø Reports Nos. 64, 86, 108, 131, 155, 181, 202, 221, 246, and 266[1].

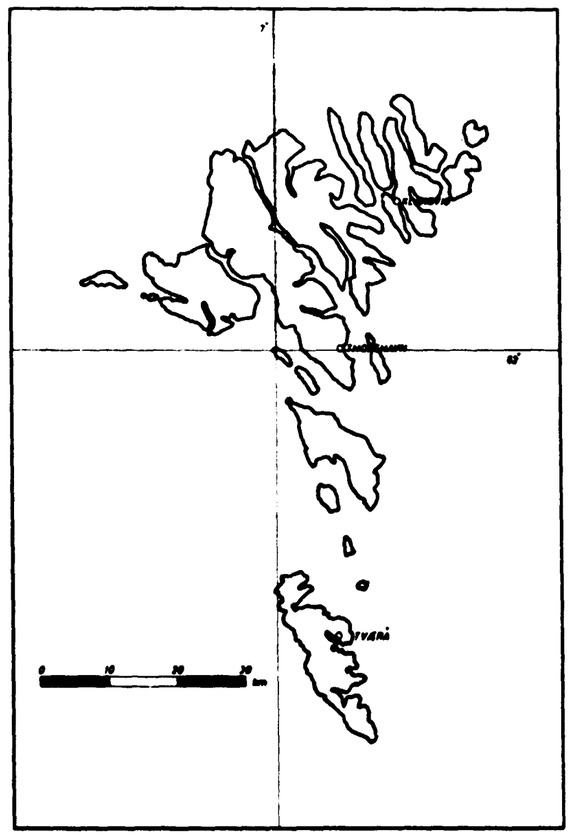

Fig. 2.1.1. The Faroes.

1.3.

The estimated mean diet of the Faroese as used in this report is unchanged as compared with 1962, i.e., it is still based on the estimate given by Professor E. Hoff-Jørgensen, Ph.D., nutritional consultant to the Danish Atomic Energy Commission.

1.4.

The present investigation was carried out along with corresponding examinations of fall-out levels in Denmark and Greenland, described in Risø Reports Nos. 291[2)] and 293[3)] respectively.

2. RESULTS AND DISCUSSION

2.1. Strontium-90 in Precipitation

Table 2.1 shows the ^{90}Sr content in precipitation collected at Høyvig (near Thorshavn) and Klaksvig in 1972. The amount of precipitation at Klaksvig was a factor of 1.7 greater than that found at Høyvig, and the amount of fall-out at Klaksvig was 1.6 times that measured at Høyvig.

Table 2.1

Sr-90 in precipitation in the Faroes in 1972

Month	Høyvig		Klaksvig	
	pCi Sr-90/l	mCi Sr-90/km^2	pCi Sr-90/l	mCi Sr-90/km^2
Jan.	2.17	0.20	0.74	0.14
Feb.	1.62	0.10	1.13	0.06
Mar.	1.46	0.13	5.40	0.32
Apr.	0.94	0.08	1.17	0.22
May	1.26	0.06	0.78	0.12
June	1.36	0.07	1.05	0.18
July	0.93	0.04	(0.78)	(0.06)
Aug.	0.61	0.04	0.51	0.10
Sep.	0.45	0.05	0.31	0.05
Oct.	0.25	0.04	0.43	0.05
Nov.	0.51	0.07	0.48	0.14
Dec.	0.40	0.05	0.24	0.05
1972	$\bar{x}$ 0.86	Σ 0.93 Σ_{mm} 1082	$\bar{x}$ 0.80	Σ 1.49 Σ_{mm} 1874

The July sample from Klaksvig was lost and the figures were therefore estimated.

The mean activity of ^{90}Sr in precipitation in 1972 was approx. one third of the 1971 levels in the Faroes. The amount of precipitation was somewhat lower in 1972 than in 1971.

2.2. Strontium-90 and Caesium-137 in Grass

Grass samples were collected near Thorshavn in 1972 as in the previous years. Table 2.2 shows the results. The mean S.U. content of the grass during the summer months was estimated at 165 S.U., and the mean S.U. in milk during June-September was 24 S.U. at Thorshavn (cf. 2.3), i.e., the observed ratio between S.U. in milk and in grass was 0.15 (mean 1965-72 0.10 ± 0.01 (1 S.E.)). The 1972 S.U. levels in grass were 40% of the 1971 levels. As compared with Danish grass in 1972[2)], we found the S.U. levels in the Faroese grass to be higher by a factor of approx. 3 in the summer months. The mean content of ^{137}Cs during the summer months was 1.15 nCi ^{137}Cs/kg or 157 M.U., i.e. larger than the 1971 levels.

The mean ratio between ^{137}Cs and ^{90}Sr in the grass (pCi/kg) was 3.9 in 1972. (Mean 1965-72: 2.2 ± 0.3).

Table 2.2

Sr-90 and Cs-137 in grass from Thorshavn 1972

Month	pCi Sr-90/g ash	pCi Sr-90/kg	pCi Sr-90/g Ca	pCi Cs-137/kg	pCi Cs-137/g K	Cs-137/Sr-90
June	9.8	434	176	1995	232	4.6
Sept.	6.8	97	153	313	81	3.2

2.3. Strontium-90 and Caesium-137 in Milk

As in the previous years[1)], fresh milk samples collected weekly were obtained from Thorshavn, Klaksvig, and Tværå. Strontium-90 and Caesium-137 were determined in bulked monthly samples.

Table 2.3.1 shows the results and tables 2.3.2, 2.3.3 and 2.3.4 the analysis of variance of the S.U., M.U., and pCi ^{137}Cs/l figures respectively. The variation between months was not significant for ^{137}Cs but highly significant for ^{90}Sr the levels being higher in the first part of the year. As also observed in previous years, the variation between locations was significant for ^{137}Cs, and probably significant for ^{90}Sr. The highest ^{137}Cs and ^{90}Sr levels were found in the milk from Tværå and Klaksvig and the lowest in the Thorshavn milk.

Fig. 2.3.1 shows the quarterly S.U. values and fig. 2.3.2 the quarterly pCi ^{137}Cs/l levels since 1962. The annual mean values for 1972 were

Table 2.3.1

Sr-90 and Cs-137 in milk from the Faroes in 1972

Month	Thorshavn			Klaksvig			Tvørå			Mean		
	S.U.	pCi Cs-137/l	M.U.	S.U.	pCi Cs-137/l	M.U.	S.U.	pCi Cs-137/l	M.U.	S.U.	pCi Cs-137/l	M.U.
Jan.	27±1	141	89	34±1*	316	208	29±1*	364	227	30	274	175
Feb.	26±3*	148	94	33±4*	302	191	29±2	262	164	29	237	150
Mar.	25±3*	163	102	27±2*	320	211	30±3*	438	288	27	307	200
Apr.	31±4	210	133	27±2*	321	203	33±1*	496	310	30	342	215
May	25±5	187	114	31±2	353	221	30±3	414	259	29	318	198
June	25±3	194	124	29	258	161	38±7	372	227	31	275	171
July	29±1	187	113	28±5	259	156	32±3	352	212	30	266	160
Aug.	22±3	187	113	20±5	158	96	21±3	343	207	21	229	139
Sep.	20	168	108	19	186	135	26	284	245	22	213	163
Oct.	11	142	87	22	267	169	15	313	196	16	241	151
Nov.	19	147	87	18	199	131	20	404	253	19	250	157
Dec.	18	129	78	25	252	152	17	395	238	20	259	156
Mean	23	167	104	26	266	170	27	370	236	25	268	170

*triple determinations

Table 2.3.2

Analysis of variance of ln pCi Sr-90/g Ca in Faroese milk 1972
(from table 2.3.1)

Variation	SSD	f	s^2	v^2	P
Betw. months	2.4345	11	0.2213	7.12	>99.95%
Betw. locations	0.2520	2	0.1260	4.05	>95%
Months x loc.	0.6839	22	0.0311	1.06	>50%
Remainder	0.9375	32	0.0293		

Table 2.3.3

Analysis of variance of ln pCi Cs-137/g K in Faroese milk in 1972
(from table 2.3.1)

Variation	SSD	f	s^2	v^2	P
Betw. months	0.6293	11	0.0572	1.82	>70%
Betw. locations	4.2293	2	2.1146	67.35	>99.95%
Remainder	0.6917	22	0.0314		

Table 2.3.4

Analysis of variance of ln pCi Cs-137/l Faroese milk in 1972
(from table 2.3.1)

Variation	SSD	f	s^2	v^2	P
Betw. months	0.6637	11	0.0603	1.89	90%
Betw. locations	3.7747	2	1.8874	58.98	>99.95%
Remainder	0.7046	22	0.0320		

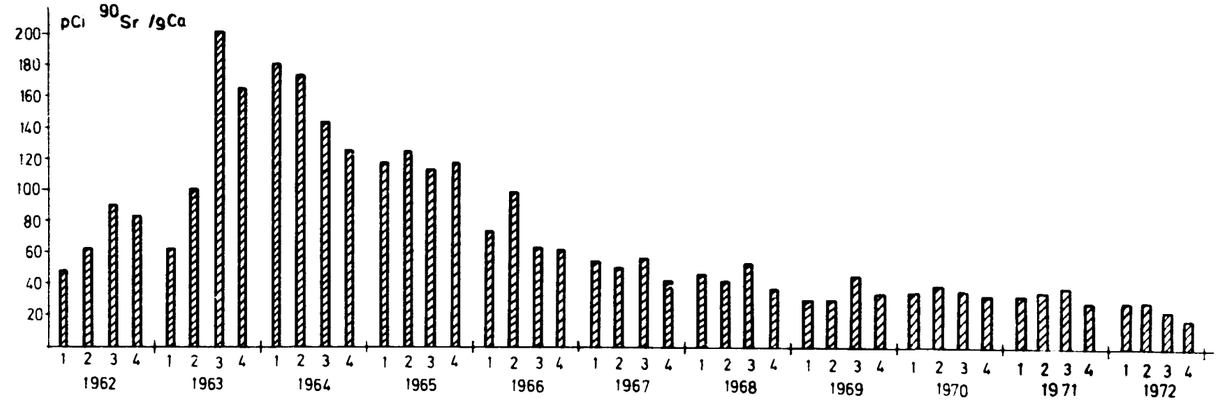

Fig. 2.3.1. Strontium-90 in Faroese milk, 1962-72.

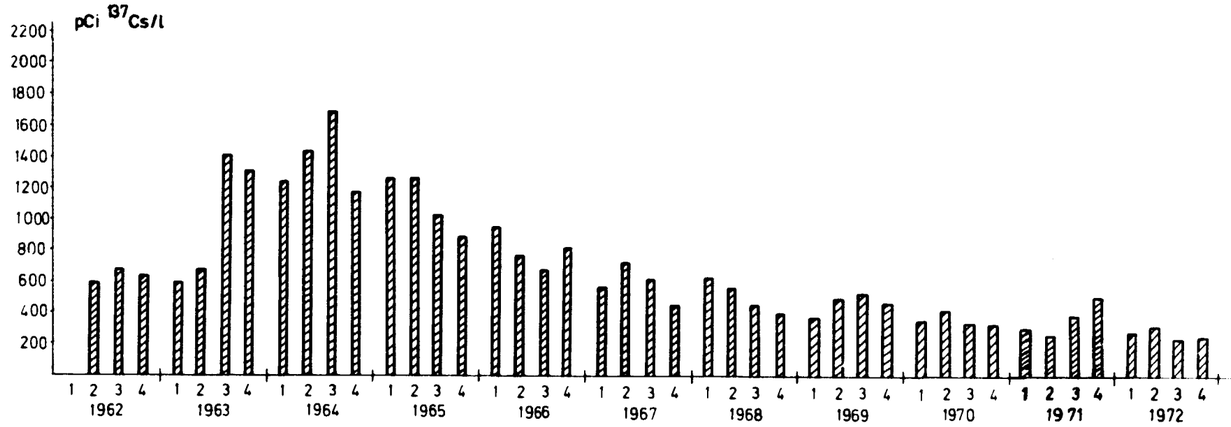

Fig. 2.3.2. Caesium-137 in Faroese milk, 1962-72.

25 S.U. (~30 pCi ^{90}Sr/l) and 170 M.U. or 268 pCi ^{137}Cs/l, i.e. the 1972 levels were lower than the 1971 mean levels. The predicted levels in Faroese milk from 1972 were 29 S.U. and 217 M.U. Prediction equations were calculated for the period 1962-70 and for an effective half life of ^{90}Sr (and ^{137}Cs) in the soil of 4 years. (Cf. ref. 2, Appendix C):

$$\text{pCi } ^{90}\text{Sr/g Ca} = 2.57\, d_{(i)} + 1.67\, d_{(i-1)} + 0.57\, A_{by(i-1)}$$

$$\text{pCi } ^{137}\text{Cs/g K} = 10.8\, d_{(i)} + 7.64\, d_{(i-1)} + 4.93\, A_{by(i-1)}$$

The observed milk levels were lower than the predicted ones; that was the opposite of the situation in Denmark[2].

The annual mean values of the M.U./S.U. ratio in Faroese milk are shown in fig. 2.3.3.

The mean M.U./S.U. ratio in 1972 was 6.9 ± 0.6 during the grazing period (May-October), and in the winter time it was 6.9 ± 0.5, i.e. unchanged. This is in agreement with previous observations[1].

Fig. 2.3.4 shows a comparison between the ^{90}Sr and ^{137}Cs levels in Faroese- and Danish-produced milk. It is evident that the soil uptake plays an important role for the ^{137}Cs levels in the Faroes.

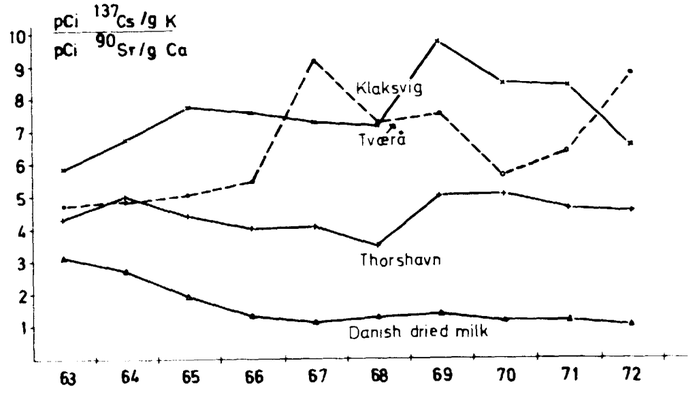

Fig. 2.3.3. $\frac{M.U.}{S.U.}$ ratios in Faroese and Danish milk, 1963-72.

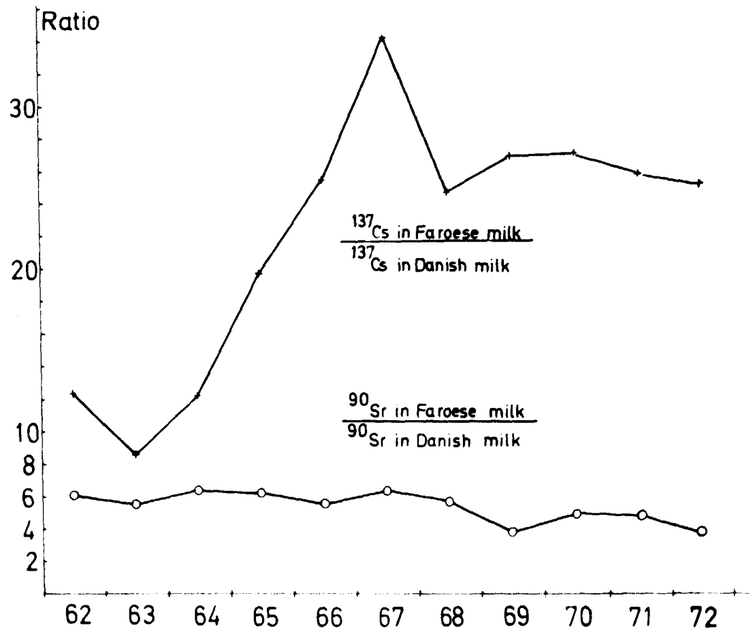

Fig. 2.3.4. A comparison between Faroese and Danish milk levels, 1962-72.

2.4. Strontium-90 and Caesium-137 in Terrestrial Animals

Lambs' meat was collected in October 1972.

The levels were 7 pCi ^{90}Sr/kg or 88 S.U. and 1.02 nCi ^{137}Cs/kg or 296 M.U. The bone level was 97 pCi ^{90}Sr/g Ca.

Table 2.4.1

Sr-90 and Cs-137 in lamb samples from the Faroes 1972

Sampling month	Sample type		pCi Sr-90/kg	pCi Sr-90/g Ca	pCi Cs-137/kg	pCi Cs-137/g K
Sept.	Fresh	Meat	7.0	88	1020±15	296±13
Sept.	-	Bone	-	97	-	-

2.5. Strontium-90 and Caesium-137 in Fish

Table 2.5.1 shows the ^{90}Sr and ^{137}Cs levels in fish collected in 1972 in the Faroes. The mean levels in fish were 0.59 pCi ^{90}Sr/kg (S.E.: 0.17) and 9.6 pCi ^{137}Cs/kg (S.E.: 1.3).

Table 2.5.1

Sr-90 and Cs-137 in sea animals from the Faroes in 1972

Sampling month		Species	Sample type	pCi Sr-90/kg	pCi Sr-90/g Ca	pCi Cs-137/kg	pCi Cs-137/g K
Jan.	Fish	Gadus aegle-finus	Meat	0.53 A	3.98 A	7.5	2.5
Jan.	"	Gadus callarias	Meat	1.62 A	4.11 A	7.4	3.1
Feb.	Fish	Gadus aegle-finus	Meat	0.37 B	5.11 B	14.9	5.5
Feb.	"	Gadus callarias	Meat	0.31 B	2.50 B	13.6	4.7
Sep.	Fish	Gadus aegle-finus	Meat	0.39 B	4.70 B	12.4 A	3.1 A
Sep.	"	Gadus callarias	Meat	1.62	8.33	9.2 B	2.7 B
Nov.	Fish	Gadus aegle-finus	Meat	0.35 B	3.07 B	6.9 A	2.5 A
Nov.	"	Gadus callarias	Meat	0.13 B	1.54 B	3.9 B	1.5 B

A: Relative S.D.: 20-33%

B: Relative S.D.: >33%

2.6. Strontium-90 in Drinking Water

Drinking-water samples were collected as previously[1]. Table 2.6.1 shows the results and table 2.6.2 the analysis of variance. As in the previous years the drinking water from Thorshavn contained more ^{90}Sr than that from Tværå (cf. the explanation in Risø Report No. 181[1]).

Table 2.6.1

Sr-90 in drinking water from the Faroes in 1972
pCi Sr-90/l

Month	Thorshavn	Klaksvig	Tværá
Jan.	1.12	0.40	0.28
Mar.	0.75	0.20	0.34
May	0.60	A 0.27	0.26
July	0.59	A 0.31	0.28
Sep.	0.26	B 0.21	0.25
Oct.	0.28	0.16	0.20
Nov.	0.44	B 0.29	0.29
Dec.	0.59	*(0.24)	0.20
1972	0.58	0.28	0.26

A: relative S.D.: 20-33%

B: relative S.D.: >33%

*Calculated from VAR 3(cf. table 2.6.2)

Table 2.6.2

Analysis of variance of ln pCi Sr-90/l drinking water in 1972
(from table 2.6.1)

Variation	SSD	f	s^2	v^2	P
Betw. months	1.9407	7	0.2772	3.27	>95%
Betw. locations	2.4730	2	1.2365	14.60	>99.95%
Remainder	1.1005	13	0.0847		

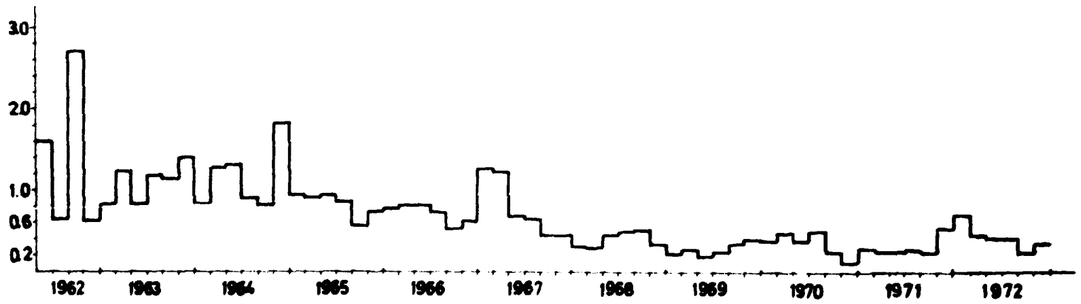

Fig. 2.6.1. Strontium-90 in drinking water, 1962-72 (mean of Thorshavn, Klaksvig, and Tværá).

Fig. 2.6.1 shows the two-monthly mean levels of ^{90}Sr in drinking water from the three locations since 1962.

The mean level in 1972 was 0.37 pCi $^{90}Sr/l$, i.e. not significantly different from the 1971 level. It is remarkable that the ^{90}Sr level in drinking water does not show the same reduction in activity as observed for precipitation (cf. 2.1).

2.7. Strontium-90 and Caesium-137 in Miscellaneous Samples

2.7.1. Soil

No soil samples were collected in 1972 from the Faroes. From earlier years' observations we estimate the accumulated fall-out at Thorshavn at 67 mCi $^{90}Sr/km^2$ and that at Klaksvig at 135 mCi $^{90}Sr/km^2$.

2.7.2. Sea Water

Surface sea water was collected near Thorshavn four times in 1972. The ^{90}Sr mean level was 0.09 pCi $^{90}Sr/l$. (1 S.E.: 0.01).

Fig. 2.7.2 shows the ^{90}Sr levels since 1962.

Table 2.7.2

Strontium-90 in sea water collected at Thorshavn in 1972

Sampling month	pCi Sr-90/l	Salinity in o/oo
Mar.	0.11	35.6
June	0.08	35.6
Aug.	0.10	35.2
Dec.	0.07	34.8

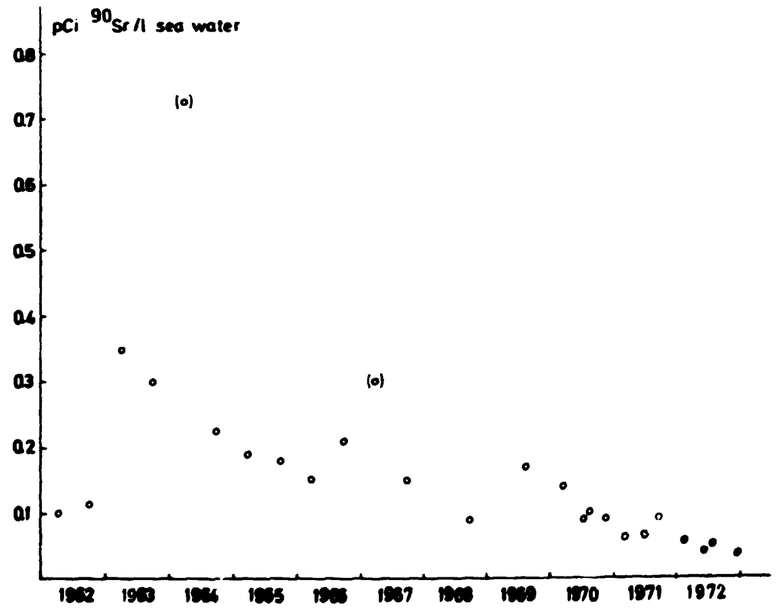

Fig. 2.7.2. Strontium-90 in Faroese sea water, 1962-72.

The sample from December was analysed for ^{137}Cs, but the level was too low for detection by Ge(Y) spectroscopy.

2.7.3. Sea Plants

Sea plants collected in September contained 1.4 pCi ^{90}Sr/g Ca (cf. table 2.7.3).

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sept.	[illegible]	[illegible]	[illegible]	-	-	[illegible]
-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
-	[illegible]	[illegible]	[illegible]	-	-	[illegible]
-	[illegible]	[illegible]	[illegible]	-	-	[illegible]
B: Relative SD: [illegible]						

2.7.4. Vegetables

Table 2.7.4 shows the results of the ^{90}Sr and ^{137}Cs determinations. No potatoes were obtained in 1972.

Table 2.7.4

Sr-90 and Cs-137 in vegetable and fruit from the Faroes in 1972

Sampling month	Species	pCi Sr-90/Kg	pCi Sr-90/g Ca	pCi Cs-137/Kg	pCi Cs-137/g K
Sept.	Mixed berry sample	13	[illegible]	46	13
-	Cauliflower	1.7 A	9.9 A	3 B	0.8 B
-	Beets	11	35	5 B	2.1 B
A: Relative SD: [illegible] B: Relative SD: [illegible]					

2.7.5. Bread

As in the previous years[1], rye bread and white bread were collected in Thorshavn in June and December. The mean levels in white bread were 9.6 pCi ^{90}Sr/kg and 15.8 pCi ^{137}Cs/kg. The rye bread collected in 1972 contained on the average 17 pCi ^{90}Sr/kg and 23 pCi ^{137}Cs/kg, i.e. the ^{137}Cs contents were lower than the 1971 levels, while the ^{90}Sr level was nearly equal to that of 1971. The Faroese bread levels were lower than the Danish[2].

Table 2.7.5

Sr-90 and Cs-137 in Faroese bread in 1972

Month	Sort	pCi Sr-90/Kg	pCi Sr-90/g Ca	pCi Cs-137/Kg	pCi Cs-137/g K
June	White bread	14.4	7.8	22.7	12.8
-	Rye bread	14.3	14.4	29.9	18.5
Dec.	White bread	4.7	5.8	8.9 A	8.0 A
-	Rye bread	20.4	9.5	16.3	7.3
A: Relative SD: 20-33%					

2.7.6. Eggs

Eggs were collected from Thorshavn in June, September and December 1972. Table 2.7.6 shows the results. The mean levels were 1.5 pCi ^{90}Sr/kg (3.06 S.U.) and 4.5 pCi ^{137}Cs/kg.

Table 2.7.6

Sr-90 and Cs-137 in Faroese eggs in 1972

Month	pCi Sr-90/kg	pCi Sr-90/g Ca	pCi Cs-137/kg	pCi Cs-137/g K
June	1.10 A	2.28 A	4.4 A	4.3 A
Sep.	2.00	4.01	4.6 A	3.3 A
Dec.	1.40 B	2.89 B	-	-
A: relative S.D.: 20-33% B: relative S.D.: >33%				

2.8. Humans

In 1972 a number of human vertebrae samples were obtained from Dronning Alexandrines Hospital in Thorshavn. Table 2.8 shows the results.

The number of bone samples from the Faroes is sparse, and it is therefore difficult to make any comparisons. Let us, however, assume that the two first samples were representative of newborns' bone in 1972 in the Faroes. The mean level is 2.8 pCi ^{90}Sr/g Ca, and from Danish measurements since 1963 we know that the observed ratio between newborns' bone and mothers' diet is 0.11. Hence the mothers' diet should have contained approx. 25 pCi ^{90}Sr/g Ca. In 1971[1] the ^{90}Sr level of the Faroese adult human diet was estimated at 15 pCi ^{90}Sr/g Ca, and in 1972 we found (cf. 3) 13 pCi ^{90}Sr/g Ca. As the bone samples were collected in July-September, it is reasonable that the estimated diet level is approx. 14. We

Table [illegible]

Sr-90 in human vertebrae and femora collected in the Faroes in 1972

Age	Month of death or sampling	Sex	pCi Sr-90/g Ca
0	7-9	F & M	2.75 *
0	5	F	2.91
1 month	4	F	3.35
57 years	5	F	1.10 **
70 -	5	M	3.14 **
55 -	12	F	1.49 **

* Bulked sample from 6 individuals (1.5 g Ca)
** Femur (from amputation)

must therefore conclude that the newborn bone levels were higher than to be expected from the diet estimate.

The ratio of ^{90}Sr in vertebrae to that in femoral diaphyses has been determined for adults in Czechoslovakia, where the average value for 51 samples was 2.28 ± 0.22 in 1969[6]. The ratio decreases with time (in 1968 it was 2.68 ± 0.31) and we will use a ratio of 2 in our recalculation of the Faroese data. Hence we estimate the Faroese mean level in adult vertebrae from the 3 femoral analyses to 3.8 pCi $^{90}Sr \pm 1.2$ or approx. twice the Danish level, which is in good agreement with a Faroese ^{90}Sr diet level twice the Danish[1,2].

3. ESTIMATE OF THE MEAN CONTENTS OF ^{90}Sr AND ^{137}Cs IN THE HUMAN DIET

3.1. Annual Quantities

As in 1962[1], the annual quantities are based on the estimate made by Professor E. Hoff-Jørgensen, Ph.D., on the assumption of a daily per capita intake of approx. 3000 calories.

3.2. Milk and Cream

75% of the milk consumed in the Faroes is assumed to be of local origin, and 25% comes from Denmark. Hence the ^{90}Sr content in milk consumed in the Faroes in 1972 was $1.2 \cdot (0.75 \cdot 25 + 0.25 \cdot 6.6) = 24$ pCi ^{90}Sr/kg, and the ^{137}Cs content was $0.75 \cdot 268 + 0.25 \cdot 11 = 204$ pCi ^{137}Cs/kg (cf. 2.3 and ref. 2). 1 kg milk contains 1.2 g Ca.

3.3. Cheese

Nearly all cheese consumed in the Faroes is of Danish origin, and the Danish figures from ref. 2 were used: 56 pCi ^{90}Sr/kg and 8 pCi ^{137}/kg.

3.4. Grain Products

As most grain products are imported from Denmark, the Danish figures for 1972[2] were used in the calculation of the Faroese levels. The mean daily consumption of grain products in the Faroes is, as in Denmark, 80 g rye flour, 120 g wheat flour, and 20 g grits. Hence the mean concentration of ^{90}Sr in grain products consumed in the Faroes in 1972 becomes 27 pCi ^{90}Sr/kg and 57 pCi ^{137}Cs/kg. We realize (cf. 2.7.5) that these activity figures probably overestimate the actual intake of ^{90}Sr from grain products in the Faroes.

3.5. Potatoes

All potatoes consumed in the Faroes are assumed to be of local origin but no samples were obtained in 1972. The values from 1971 were therefore used, i.e. 8 pCi ^{90}Sr/kg and 72 pCi ^{137}Cs/kg.

3.6. Other Vegetables and Fruit

As the amount of vegetables and fruit grown in the Faroes is limited, the Danish figures from 1972[2] were used. Thus the mean contents in vegetables other than potatoes were 12 pCi ^{90}Sr/kg and 2 pCi ^{137}Cs/kg, and the mean contents in fruit were 3 pCi ^{90}Sr/kg and 4 pCi ^{137}/kg.

3.7. Meat and Eggs

The meat and egg consumption in the Faroes is estimated to consist of 50% locally produced mutton (or lambs' meat), 25% local whale meat, and 25% sea birds and eggs.

The mutton contained 7 pCi ^{90}Sr/kg and 1.02 nCi ^{137}Cs/kg (cf. 2.4). Whale meat from 1970[1] contained 5.5 pCi ^{90}Sr/kg and 850 pCi ^{137}Cs/kg, sea birds from 1970[1] and eggs (cf. 2.7.6): both 1.5 pCi ^{90}Sr/kg and 15 and 4.5 pCi ^{137}Cs/kg respectively.

Hence we estimate the mean content of ^{90}Sr in meat and eggs consumed in 1972 to be

$$0.50 \cdot 7 + 0.25 \cdot 5.5 + 0.25 \cdot (\frac{1.5 + 1.5}{2}) = 5 \text{ pCi } ^{90}Sr/kg$$

and the ^{137}Cs content to be

$$0.50 \cdot 1020 + 0.25 \cdot 850 + 0.25 \cdot 10 = 725 \text{ pCi } ^{137}Cs/kg.$$

3.8. Fish

All fish consumed in the Faroes is of local origin, and the mean contents in fish, obtained from subsection 2.5, were 0.6 pCi ^{90}Sr/kg and 10 pCi ^{137}Cs/kg.

3.9. Coffee and Tea

The Danish figures for 1972[2] were used, i.e. 24 pCi ^{90}Sr/kg and 106 pCi ^{137}Cs/kg.

3.10. Drinking Water

The mean value found in table 2.6.1 was used, i.e. 0.37 pCi ^{90}Sr/l. The ^{137}Cs content was estimated to be approx. one fourth (the ratio found in New York tap water in 1964[4]) of the ^{90}Sr content, i.e. 0.1 pCi ^{137}Cs/l.

Table 3.1

Estimate of the mean content of Sr-90 in the human diet in the Faroes in 1972

Type of food	Annual quantity in Kg	pCi Sr-90 per Kg	Total pCi Sr-90	Percentage of total Sr-90 in food
Milk and cream	146	24	3504	45.4
Cheese	7.3	56	409	5.3
Grain products	80	27	2160	28.0
Potatoes	91	8	728	9.5
Vegetables	20	12	240	3.1
Fruit	18	3	54	0.7
Meat and eggs	37	5	185	2.4
Fish	91	0.6	55	0.7
Coffee and tea	7.3	24	175	2.3
Drinking water	548	0.37	203	2.6
			7713	

The mean annual calcium intake is estimated to be 600 g (approx. 200-250 g creta praeparata). Hence the pCi Sr-90/g Ca ratio in total Faroese diet was 13 S.U., and the mean daily intake was 21 pCi Sr-90.

Table 3.2.

Estimate of the mean content of Cs-137 in the human diet in the Faroes in 1972.

Type of food	Annual Quantity in Kg	pCi Cs-137 per Kg	Total pCi Cs-137	Percentage of total Cs-137 in food
Milk and cream	146	1020	148920	19.2
Cheese	7.3	850	6205	0.8
Grain products	80	27	2160	0.3
Potatoes	91	10	910	0.1
Vegetables	20	-	-	-
Fruit	18	-	-	-
Meat and eggs	37	725	26825	3.5
Fish	91	10	910	0.1
Coffee and tea	7.3	106	774	0.1
Drinking water	548	0.1	55	0.1
			186630	

The mean annual intake of potassium is estimated to be approx. 1200 g. Hence the Cs-137/g K ratio becomes 58 and the daily intake of Cs-137 191 pCi.

Tables 3.1 and 3.2 show the diet estimates of ^{90}Sr and ^{137}Cs respectively.

3.11. Discussion

Fig. 3 shows the Faroese diet levels since 1962.

The 1972 levels in total diet were a little lower than in 1971.

The main contributors of the ^{90}Sr content in the Faroese diet were milk products and cereals, which together accounted for 3/4 of the total

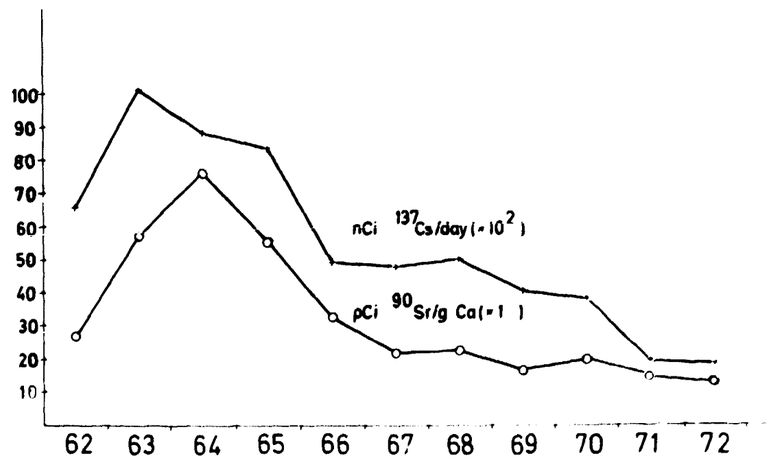

Fig. 3. Strontium-90 and Caesium-137 in Faroese diet, 1962-72.

^{90}Sr content in the diet in 1972. As regards ^{137}Cs, milk products, meat (lamb), and potatoes were the most important contributors. In 1972, approx. 90% of the total ^{137}Cs content in the diet came from these products.

The Faroese mean diet contained 1.6 times as much ^{90}Sr and approx. six times as much ^{137}Cs as the Danish 1972 diet[2].

4. CONCLUSION

4.1.

The ^{90}Sr fall-out rate in the Faroes in 1972 was approx. 1.2 mCi $^{90}Sr/km^2$. The accumulated fall-out by the end of 1972 was estimated at approx. 101 mCi $^{90}Sr/km^2$ (the mean of Thorshavn and Klaksvig).

4.2.

The mean level of ^{90}Sr in Faroese milk was 25 S.U. or 30 pCi $^{90}Sr/l$. The ^{137}Cs concentration was 170 pCi $^{137}Cs/g$ K, or 268 pCi $^{137}Cs/l$.

Lamb contained 7 pCi $^{90}Sr/kg$ and 1 nCi $^{137}Cs/kg$. Fish showed mean levels of 0.6 pCi $^{90}Sr/kg$ and 10 pCi $^{137}Cs/kg$.

The mean content of ^{90}Sr in drinking water was 0.37 pCi/l.

The mean daily per capita intakes with the diet in the Faroes in 1972 were estimated at 21 pCi ^{90}Sr (13 S.U.) and 191 pCi ^{137}Cs (58 pCi $^{137}Cs/g$ K), i.e. nearly the same as in 1971.

4.3.

From the Faroese and Danish diet estimates and from measurements on deciduous teeth[5] and Faroese and Danish bones, the Faroese bone levels in 1972 were estimated as follows: in new-born children: approx. 3 S.U.; in infants (1 month - 4 years): approx. 6 S.U. (depending upon the amount of locally produced milk in the diet of the infants); in children and teen-agers (5 - 19 years): approx. 4 S.U.; in adult vertebrae: approx. 4 S.U.

The mean content of ^{137}Cs in the Faroese adult was estimated at approx. 13 nCi or approx. 110 pCi $^{137}Cs/g$ K. This estimate was based on the Faroese and Danish diet estimated in 1971-72 and on Danish whole-body measurements in 1972.

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